traversed. Specifically, as discussed in more detail below, Applicant respectfully submits that the Mallinckrodt et al. and Honkasalo et al. patents relate to CDMA cellular networks, not to a wireless ad-hoc communication network as recited in the claims. Hence, Applicant submits that neither patent teaches or suggests the operations of computing path loss in a link *of a wireless ad-hoc communications network* based on information provided to a source node from a destination node in that type of network, determining a noise factor representing noise at the destination node, and then calculating the power level and/or data rate at which data is transmitted over the link based on the path loss and noise factor.

The details of the rejected claims and the cited references will now be discussed.

An embodiment of the present invention provides a technique for determining a power level and/or rate at which data is transmitted over a link between source and destination nodes in a wireless ad-hoc communications network. As described in the specification and as can be appreciated by one skilled in the art, a wireless ad-hoc communications network comprises a plurality of mobile and stationary nodes that can communication with each other directly or via one or more other nodes that operate as a router or routers for data packets being sent between nodes. In other words, an ad-hoc communications network does not employ base stations as do, for example, cellular telephone networks. As can further be appreciated by one skilled in the art, an ad-hoc communications network is capable of self-healing or, in other words, establishing different paths or links between nodes when an existing path becomes unusable. For instance, if a node in a path becomes inoperative or inaccessible, the other nodes in the path will establish communication with a different node and use that different node to reestablish the path.

Independent claim 1 defines this embodiment as a method for determining a power level and/or rate at which data is transmitted over a link between source and destination nodes in a wireless ad-hoc communication network. The method comprises the steps of computing path loss in the link based on information provided to the source node from the destination node pertaining to characteristics of a message that was transmitted by the source node for receipt by the destination node, determining a noise factor representative of noise at the destination node, and calculating the power level and/or rate at which the data is transmitted over the link from the source node to the destination node based on the path loss and the noise factor. Independent claim 13 defines the embodiment as a computer readable medium of instructions for performing these operations.

The Mallinckrodt patent teaches a power control technique for a cellular mobile communications system employing integrated satellites and terrestrial nodes to prevent fading, shadowing, interference and other problems. As described, for example, in column 3, lines 56-59 and beginning at column 10, line 40, the technique computes the path loss between a transmitter and receiver (e.g., between a transmitter of a satellite 20 and a receiver of a user unit 22) based on the strength of the received signal and information contained in the transmitted signal pertaining to the transmit power. The quality of received information is estimated using the Signal-to-Noise Ratio (SNR) and the bit error rate. The transmit power of the transmitter can then be adjusted so as to achieve the desired signal quality.

As discussed above, Applicant respectfully submits that the Mallinckrodt patent fails to teach or suggest a wireless ad-hoc communications network. Based on statements in the Office Action, the Examiner evidently believes that because the transmitters and receivers in

Mallinckrodt network can be mobile as described in column 5, lines 30-41, the network is therefore an ad-hoc network. Applicant respectfully notes that merely mobility does not make a network an ad-hoc network. Rather, Applicant submits that the Mallinckrodt network is nothing more than a Code Division Multiple Access (CDMA) network having power control features. Therefore, as will now be explained, the types of "links" in a CDMA network are unlike those in an ad-hoc network. Accordingly, any analysis of the links in the CDMA network as taught by the Mallinckrodt patent would not apply to the links of an ad-hoc network.

As can be appreciated by one skilled in the art, CDMA operates by converting speech into digital information, which is then transmitted as a radio signal over a wireless network. Using a unique code to distinguish each different call, CDMA enables many units to share the airwaves at the same time without static, cross-talk or interference. CDMA is used for supporting the radio communication between *mobile* phones and *fixed* base stations. In some networks, such as that taught by the Mallinckrodt patent, geo-stationary satellites are used to provide base station functionality. The base station and the mobile stations (usually portable phones) use two radio channels of different frequencies. The base station transmits continuously in the downlink (or reverse) frequency channel, while the mobile stations transmit in the up-link (or forward) frequency channel. This frequency planning allows both sides of each link to transmit and receive continuously. Several traffic channels are implemented on each of the two frequency channels. Each traffic channel is encoded using a different code. The digital information is encoded at transmission site using the selected code. The same code is used at reception site for decoding the received information.

In the downlink channel, the base station encodes the information to be transmitted to each mobile using the proper codes and transmits the weighted sum of all encoded data at once using a unique transmitter. All mobile stations receive the same signal, but each station uses a different code for decoding the data. On the other frequency each mobile station encodes and transmits the data. The base station receives the interference as a sum of radio signals transmitted by all mobile stations and decodes it using the same codes that the mobiles were using for encoding. As result, from one received signal, the base station decoder generates as many sets of data as the number of mobile stations in operation. Control channels are implemented on top of the traffic channels in the same radio frequency which allow for the exchange of auxiliary information between mobile stations and the base station. Data exchanged in control channels defines the conditions for properly exchanging the voice data, the code for encoding and decoding the voice data, the transmitting power level, the data rate, the caller ID, "off/on hook", and so on. The control channels are also encoded using the special code of the control channel. Because the information transmitted in control channel is very sparse, only one control channel can provide the control information for a large number of mobile stations. For this reason, only one control channel is used for communicating with all mobile stations.

The radio signal received in a CDMA frequency channel has almost the same characteristics as noise because it is the result of adding (interfering) signals from several sources. The decoder selects from this "noise" the useful information and ignores the useless one. A base station includes several decoders running in parallel, with each one retrieving the information from one particular traffic channel. Therefore, each decoder filters out the useless

information by considering it as noise. Because the information is transmitted simultaneously by several stations, it is very important that the noise level (from useless or undesired information) at the receiving point is smaller than the level of the useful information, otherwise the useful information cannot be recovered from the noise. The CDMA systems work well for communicating digital information, where the unit of information is one binary bit (zero or one that in wireless communication is transmitted as either plus one or minus one). The level of the received signal depends on the amount of energy used at transmission site and the amount of energy lost due to environment absorption. This absorption is known as "path loss" which increases with the length of the distance the radio waves travel in environment. The quality of the received information depends on the relation between the level of the received signal and the level of noise at the reception point. Because the environment absorption and the external sources of noise are difficult to control, the quality of reception is controlled by adjusting the amount of transmitted energy per bit of information. In CDMA, due to the noise from environment, the transmitted signal carries a large amount of energy pertaining to the undesired information to/from the other stations, which is noise for the decoder. Therefore, balancing the amount of energy per bit between all traffic channels is very stringent when attempting to assure correct reception of information. Since the power of the transmitter is limited, when encoded signals are added at base station transmitter, a proper weighting method can be used to assure that all mobile stations located at large or close distances, receive the proper signal carrying the useful information.

As can further be appreciated by one skilled in the art, unlike a CDMA network, an ad-hoc network does not require a hierarchical structure. As in the CDMA network taught by the

Mallinckrodt patent, a base station is at the center of the network and communicates with all mobile stations within its range. If two mobile stations from the same network have to communicate one with another, they can only do so through the base station. When base stations are deployed, a study is made to identify the territorial boundaries of the cell within which the base station provides service. In cell based systems, the relation is hierarchical, as one component (i.e., the base station) enables communication between the mobile stations. Such a system also uses uplink and downlink frequencies as discussed above.

On the contrary, in ad-hoc networks, any two mobile stations can talk directly one with another, if they are close enough. If they are far away, other mobile stations located between these two stations that need to communicate, provide the relay service transferring data packets back an forth. Hence, the structure of the ad-hoc network is horizontal as opposed to hierarchical. In a horizontal system, since all nodes have the same transmitting and receiving functionality, they cannot use uplink and downlink frequency channels, and can thus use only one frequency. More than one frequency channel could be implemented for increasing the system throughput, but it is not a minimal requirement for ad-hoc networks. Also, in ad-hoc networks, the communication is not continuous, as each station first listens before transmitting the data to the next hop. While one station is transmitting and another one is receiving, all stations in the neighborhood remain silent to prevent causing interference.

Another important difference between ad-hoc networks and CDMA cellular networks relate to variations in the path loss. Since ad-hoc networks work at very low energy, the distance between stations are much smaller than the distances in cellular systems and extremely smaller than distances to satellites. Thus, the path loss, which has a logarithmic variation with

the distance, varies rapidly when two mobiles move in opposite direction at close distances. The very fast variation of the path loss has to be considered when computing the transmit energy per bit for preventing the use of too much energy when the two mobile are approaching or the use of too little energy (and lose data) when they are departing.

Accordingly, as demonstrated above, any type of path loss that would be calculated for a link in a CDMA system such as that taught by the Mallinckrodt patent would be unlike that performed by the claimed embodiment of the present invention for a link in an ad-hoc network. Furthermore, nowhere does the Mallinckrodt patent teach or suggest calculating a noise factor that is specifically representative of noise *at the destination node*. Column 10, lines 53-62 and column 12, lines 43-50 merely mention that signal quality can depend on noise, and take into account the signal-to-noise ratio (SNR). However, there is no specific calculation of a "noise factor".

Concerning the Honkasalo et al. patent, Applicant submits that like the Mallinckrodt patent, the Honkasalo et al. patent teaches a CDMA network which is unlike an ad-hoc network as demonstrated above. The Examiner relies on the Honkasalo patent as allegedly teaching that a transmit data rate can be determined based on transmit power.

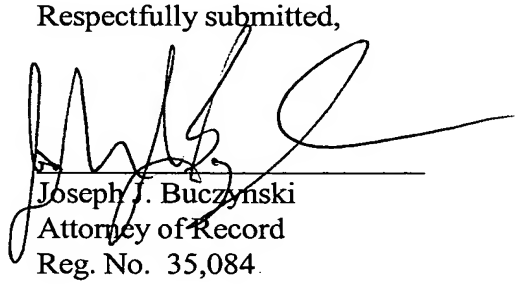
Applicants respectfully submit, however, that the Honkasalo patent fails to make up for the deficiencies in the teachings of the Mallinckrodt patent as discussed above. That is, the Honkasalo patent fails to teach or suggest the path loss computing and noise factor determining operations which are not sufficiently taught by the Mallinckrodt patent. Moreover, even though the Honkasalo patent may teach that the data rate is related to the transmit power, the Honkasalo

patent fails to teach that the transmit power and/or data rate are calculated based on this calculated noise factor as well as path loss.

For all these reasons, Applicant respectfully submits that one skilled in the art would not have found it obvious or possible to achieve the present invention as recited in even independent claims 1 and 13 based on the teachings of the Mallinckrodt and Honkasalo patents. These patents also fail to teach the more specific details recited in the dependent claims, such as the dynamic path loss calculation, the short term fading calculation, and so on. Accordingly, independent claims 1 and 13, and all of their dependent claims, should be allowable.

In view of the above, it is believed that the subject application is in condition for allowance, and notice to that effect is respectfully requested. However, should the Examiner have any questions, the Examiner is invited to contact the undersigned at the number indicated below.

Respectfully submitted,



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